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Water quality in a rural river environment: distribution of metals among water and sediment compartments

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Sediments have a significant influence on water quality, owing to their role both as a sink and a potential source of pollutants. In fluvial environments from mountainous catchments, the dynamics of sediment particles and particle-bound contaminants are still poorly understood. As stated by Symader et al. (2007), bottom sediments of small rivers in mountainous areas behave like a transport system of its own and show high temporal variation in their chemical composition. The transport of significant sedimentary loads, as suspended matter, in short periods of time, mainly in winter, poses some issues concerning monitoring and modelling approaches of the transport and fate of micro-pollutants at the catchment scale. On one hand, high stream-flow velocity peaks make it difficult or impossible to maintain suspended sediment samplers fixed in the river channel. On the other hand, the cycle of deposition and re-suspension of finer material, throughout the hydrological year, leads to temporal changes of sediment properties.

Our contribution reports some results of an investigation on the water quality in a mountainous rural meso-scale catchment, located in the NE of Portugal. The study integrates the examination of metal contents in the sediments and the water body. The river-bottom sediments and water were simply collected in a planned sampling network, in two different periods of the hydrological year (high and low flow). The finer and most recently deposited sediment was preferentially sampled, and the <63μm granulometric class analysed for the potentially bioavailable fraction. Three metals were considered to illustrate the observations resulting from the combination of data on its dissolved and particulate contents. These are Cu, Pb and Zn, which show similar spatial and temporal distributions at the catchment scale. In the main streams a general increase of metal contents in the potentially bioavailable fraction is observed downstream. The residual fraction decreases in high-energetic sites of the drainage network. No simultaneous variation trends in the metal contents in the water and in the sediment fractions studied are observed. The transport mechanisms and the exchange of material exert a joint influence. Regarding the possible origin of the considered elements we observe peaks of contents in sites influenced by geological mineralisation and urban effluents. The influence of agricultural practices in the fluvial environment quality is more noticeable in the zones of the basin where small agricultural fields, in narrow terraces, are inter-related with urban settlements. In the valleys the impact is lower; the soil layer is thicker and the topography is smoother, attenuating the superficial transport and higher retention of these metals in soils.

The results show that the pollutant dispersion and transport in mountainous fluvial environments is governed by multiple interrelated factors difficult to control over time, and predictive models still need better information about the processes governing the transport into and within the fluvial network. The regular monitoring of bed sediments in this kind of basins is important to give some insight into the micro-pollutant transport in small mountainous catchments with an impact on the quality of receiving waters.

Symader, W.; Bierl R.; Kurtenbach, A.; Krein, A. (2007). Transport Indicators. In: Sediment Dynamics and Pollutant Mobility in Rivers (eds Westrich, B. & Forstner, U.), pp. 269-304, Springer.